HORIZONS

DECEMBER 1968 / PAN AMERICAN PETROLEUM CORPORATION

Unlocking the Athabasca Tar Sands...see page 1

"Fire Flood" is key to . . .

Unlocking the Athabasca Tar Sands

Tar flows like oil as Pan Am successfully field-tests unique burning process in Alberta wilderness where vast reserves lie buried 1,000 feet beneath the surface

In its natural state in the McMurray formation, the substance is practically solid and immobile. When produced by our process, it flows like conventional oil. Here at our project site, Karol Hujsak, research group supervisor from Tulsa, samples the tar.

RICAN PETROLEUM CORPORATION
Tulsa, Oklahoma 74102
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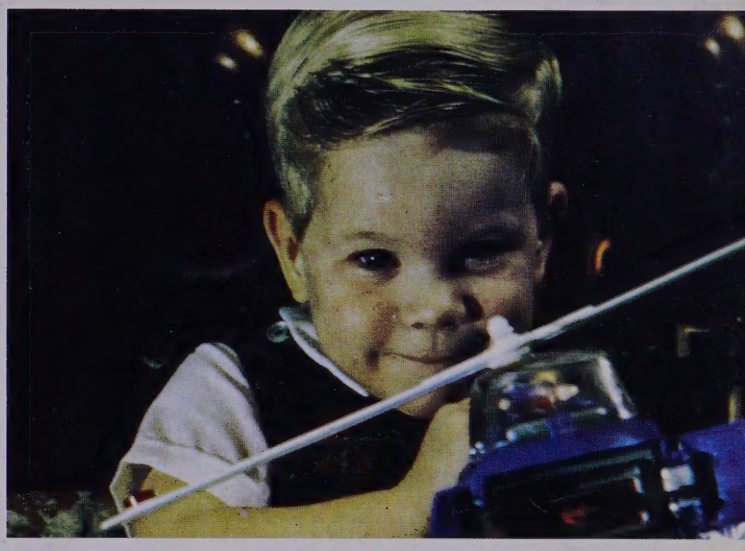
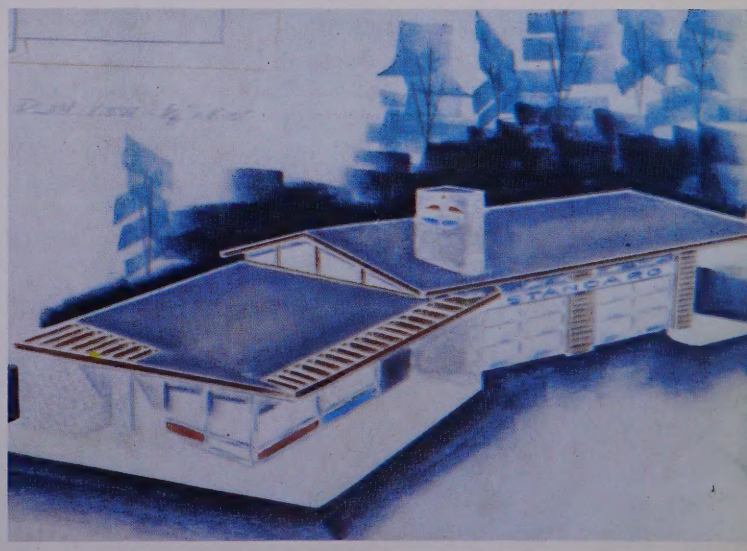
IN THIS ISSUE

ATHABASCA TAR SANDS — Economic recovery of billions of barrels of Athabasca tar is the aim of Pan Am's new "fire flood" process. **PAGE 1**



TOYS FROM PETROLEUM — To youngsters, whether or not they are aware of it, happiness can be a barrel of oil. **PAGE 9**

TSMA AUTOMATION — Technology enables Pan Am to operate Louisiana inland and offshore gas province in ultramodern style. **PAGE 12**



DESIGNING A SERVICE STATION — Many demands must be satisfied in determining how a new service station should look. **PAGE 17**

ALSO

MILESTONE FOR HYDRAFRAC — Pan American-developed hydraulic fracturing process recently energized its 500,000th well. **PAGE 6**

LITHO IN U.S.A.

Pan Am Foundation To Sponsor 17 Scholarships

SEVENTEEN SCHOLARSHIPS in petroleum engineering, geophysics and geology during the 1969-70 academic year will be sponsored by the Pan American Petroleum Foundation.

Represented in the Foundation's program are petroleum engineering awards to the University of Alabama, Colorado School of Mines, Mississippi State University, Montana College of Mineral Sciences and Technology, University of Oklahoma, Texas A&M, Texas Tech, and the University of Texas.

Geological grants are being offered to Florida State, Lamar State College of Technology, University of Nebraska and Southern Illinois University, and geophysical scholarships will go to students at Colorado School of Mines, Florida State University, University of North Carolina, Texas A&M and Texas Tech.

The program is designed to encourage better students to enter the petroleum-related sciences. Applications should be directed to the institutions, which will be responsible for the selection of candidates and administration of awards.

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STANDARD OIL (INDIANA) STOCK averaged $54.9862 per share for the month of September, and $58.6298 for the month of October. These prices were the basis for stock purchases for employees who participate in our company's savings plan.

HORIZONS

Vol. XVIII, No. 6, Published and Copyrighted by Pan American Petroleum Corporation, Tulsa, Oklahoma. Editor: R. N. Murphy. Staff Photographer: B. G. Houston. Pan American is a wholly owned subsidiary of Standard Oil Company (Indiana). It conducts North American operations involved in finding and producing crude oil, natural gas liquids and sulfur, and purchase and sale of natural gas and crude oil.

IN THE FAMILY

Our affiliate, **AMERICAN INTERNATIONAL OIL COMPANY,** has established Amoco Europe in London to provide advice and coordination for subsidiary operations. Amoco Europe will coordinate existing marketing, manufacturing, exploration and production activities in Italy, Germany, the Netherlands, Norway and the United Kingdom.

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Meanwhile, **AIOC's** subsidiary, Pan Am United Arab Republic Oil Company, has tested oil at an exploratory well in the Gulf of Suez. Oil was produced on short tests from three relatively thin formations from a well located about nine miles south of El Morgan field. Drilling and testing is continuing to evaluate the well.

Amoco Mauritania, another **AIOC** subsidiary, is drilling a wildcat well in African waters off the coast of Mauritania. The well is located about 25 miles offshore and 130 miles southeast of Port Etienne. It is drilling in 250 feet of water from the 9,200-ton "Glomar North Sea" drill ship.

• • • • • • • • • • • •

AMOCO CHEMICALS CORPORATION is building its second major structure, a new research laboratory at the Naperville Technical Center, southwest of Chicago, where the company has a technical service laboratory under construction. The new three-story building will contain about 240,000 square feet. When the lab is finished in mid-1970, it will house about 550 people.

NEW HORIZONS

PAN AM WAS THE WINNING BIDDER with our partner, Mobil, on two Louisiana offshore tracts at a drainage sale held last month. High bids were submitted on East Cameron Blocks 9 and 14 — 2,187 acres and a total bonus of $4,873,438.

Meanwhile, over the past month, our company announced two significant discoveries. The Pan Am No. 3, OCS-G-1069, in West Delta Block 35, is our eighth successful offshore Louisiana wildcat this year. The well encountered oil and gas from two zones. It flowed 250 barrels of condensate and nearly 4 million cubic feet per day of gas on a one-hour test from a pay interval below 12,000 feet. We are now planning development in the area.

In the southeastern corner of New Mexico, near the northern edge of the Delaware Basin, our No. 1 Trigg Federal B was completed for a gauge of 7 million cubic feet of gas per day. The well has 39 feet of net pay in four separate sand zones at about 9,650 feet. Nearest production from the Morrow sand is two miles in one direction and nearly five miles in another. We have 2,500 net acres held by production in a nine-section block adjacent to and including the well site.

RETIREMENTS

40 YEARS AND OVER

William R. McLean, pumper.....Salt Creek

30 YEARS AND OVER

Harold E. Baker, sr. landman.....Denver
Greta L. Berglund, staff assistant (sg)....Tulsa
Karl Dyk, chief geophysicist.....Tulsa
Ozemay Louvier, roustabout.....Lake Charles
Charles W. Vest, permitman.....Ft. Worth

20 YEARS AND OVER

Alvin L. Cutler, precision machinist.....Tulsa
Roy N. Davis, pumper.....Beaumont
Elvin K. Edwards, facility plant operator-pumper.....Hastings
Jewell P. Langford, roustabout.....Tyler
Clyde S. Merritt, roustabout-pumper.....Liberal
Warren S. Schlicht, repairman.....Salt Creek

10 YEARS AND OVER

Clarence E. Waters, repairman-meterman.....Levelland
Joseph B. Whitlock, maintenance foreman.....Old Ocean
Frank J. Witt, draftsman.....Ft. Worth

.E INDIANS in the forest and uskeg country of northeastern Al- waterproofed their canoes with it. plorers, trappers and traders puzzled the black, gummy substance some ears ago as it oozed from the banks : Athabasca River.

plogists, near the turn of our cen- decided to take a deeper look by g into the Athabasca tar deposits are exposed at the surface in some ; and buried as deep as 2,000 feet ners.

the extent of this abundant hydro- n deposit began to be more fully ed, the race was on to find technical conomic ways to recover the valu- resource.

e stakes are high.

e deposits contain far more oil than een produced in the entire history nada and the United States com- . Some say the famous deposits d over eight million acres and hold than 600 billion barrels of bitumen, -like substance closely akin to oil.

cause of these enormous reserves, nber of companies and government ies began to study ways to either and separate the tar, or produce ough in situ (in place) methods. ns of companies became involved, he first attempts at commercializa- tarted in the 1930s. While a large- mining project was begun last fall, mmercial in situ operation has been ed to date.

fter years of research in the lab and ade of field research, our company ow come up with an answer that great promise for our company and lberta," says John C. Meeker, vice lent and general manager of our ry division.

is December our company announced our new "fire flood" process has successfully tested at a site 225 miles east of Edmonton and 25 miles east of the "frontier" town of Fort urray. The McMurray tar-bearing tion is found at about 1,000 feet in rea and ranges in thickness from o 340 feet.

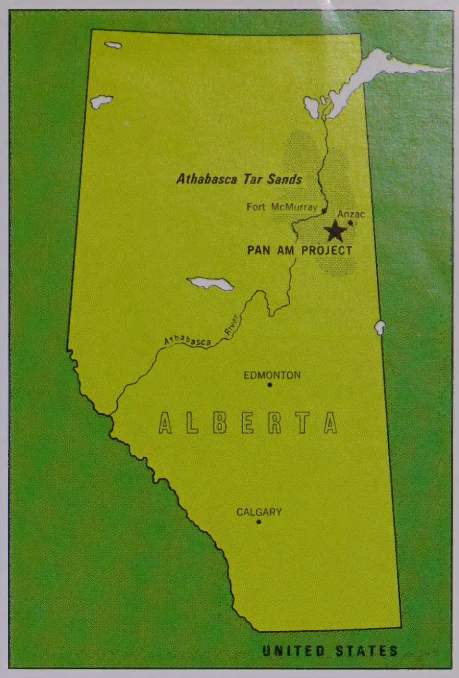
There were many technical obstacles that plagued first attempts to produce the tar in satisfactory quantities. But each subsequent experimental phase brought us closer to production capability. Our fifth phase—a one-half-acre pilot operation—was launched in 1965. Production was started in June 1967. From then to October, 1968, total production has amounted to 20,000 barrels of raw bitumen. Heated lines must be used to carry the sticky substance to tanks. Two of the wells in this test were still producing at a total rate of 50 barrels daily this fall.

"These good results prompted us to submit an application to the Alberta Oil and Gas Conservation Board, requesting approval to produce up to 8,000 barrels of raw bitumen daily within several years," Meeker says. The application, filed by our subsidiary, Muskeg Oil Company, is pending, and the hearings are scheduled early in 1969.

The Pan Am vice president points out that mining and hot water separation are already conducted on a large scale by Great Canadian Oil Sands, Ltd., 20 miles north of Fort McMurray. But since about 90 percent of the Athabasca deposit is not suited to surface mining techniques, our goal at Pan Am has been to find a way to produce the bitumen through well bores much as you would produce conventional oil.

"The 8,000-barrel-daily production would be the initial step in an overall plan providing for a gradual buildup in production to higher levels," Meeker explains. "The company expects to make an additional application at a later date to implement the remainder of the overall plan."

This gradual development of the sands should allow the product to enter the market smoothly without disruptions in supply and demand patterns, according to Kenneth J. Barr, Calgary division production manager. Barr explains the Pan Am production would be transported by pipeline from the project to the Whiting, Indiana refinery operated by our affiliate, American Oil Company. For the proposed project, Alberta's Oil Sands Development Policy would require processing of equal quantities of conventional Canadian crude.



Our most recent tests to recover Athabasca tar have been carried out in the wilderness of northeastern Alberta—seven miles from Anzac and 25 miles southeast of Fort McMurray.

With the gradual development of the tar sands, a slow change is occurring in the "frontier" environment of this area of lakes, bush, muskeg and very few people.

"The nearest settlement to our campsite is the wilderness railhead of Anzac about seven miles northeast," comments Grant Trimble, engineering group supervisor in the Calgary division. "Fort McMurray, 25 miles northwest of our project, is the only sizable town in the entire region."

As of now, the only "dwellings" at our project site are aluminum "skid shacks" set closely together and connected by boardwalks, where Pan Am employees and contract personnel eat and sleep.

For some years, a number of Pan Am people have beaten a steady path to

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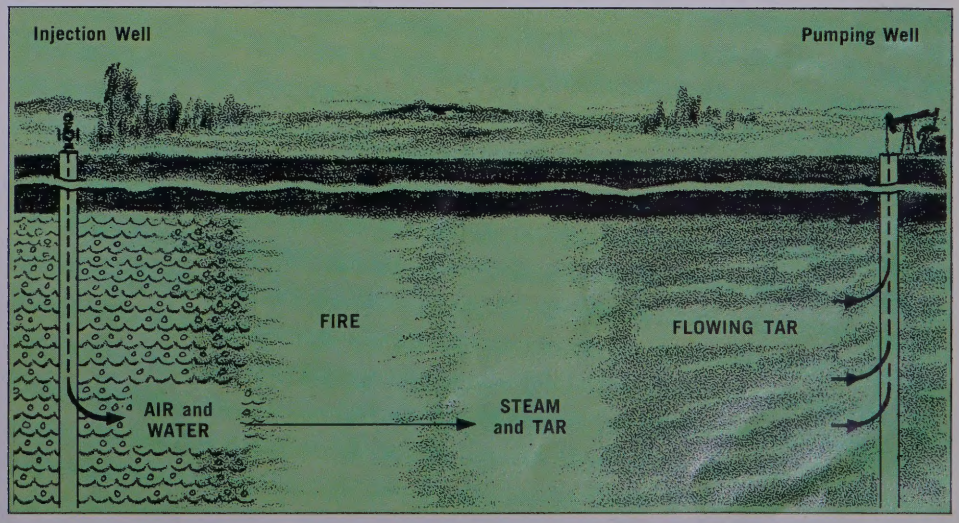


This drawing illustrates how our new burning process works in the tar sands at a depth of about 1,000 feet. Through the injection well, the formation is fractured and heated. The viscosity of the tar is thus reduced so that it can be made to flow readily. Injected water, which vaporizes and passes through the combustion front, carries heat from behind to ahead of the front. The oil is then displaced ahead of the combustion front into the producing wells.

R: Athabasca tar is recovered, melted ack, from about 1,000 feet by use of a Pan Am-patented "fire-flood" process. ubsurface formation is heated to an e of at least 200 degrees. This reduces cosity, enabling the gummy substance easily.

Athabasca Tar Sands

continued

this remote geographic as well as technical frontier. Those who have spent a great deal of time at the site include Field Foremen John Christian and Vic Desaulniers, and George Jenkins, petroleum engineer (sg) of the Edmonton area office.

In addition to Karol Hujsak, research group supervisor and project leader, several Pan Am employees from the Tulsa Research Center — including John Kirkpatrick and Earl Gum, senior research engineers, and Dick Mungen, research section supervisor — are familiar with Pan Am's unpaved airstrip near Gregoire Lake and the pungent smell of muskeg. In fact, to Hujsak, Kirkpatrick and Gum, northeastern Alberta represented their "home away from home" for the past 10 years. Hujsak explains how the new technique works in the field:

"After drilling into the tar formation, we use the company's patented Hydrafrac process to fracture the formation. Air is then injected and the tar ignited to heat the formation, around the injection well.

"The objective of the in place burning process," Hujsak says, "is to increase the formation temperature to at least 200 degrees. When this occurs, the tar is able to flow readily."

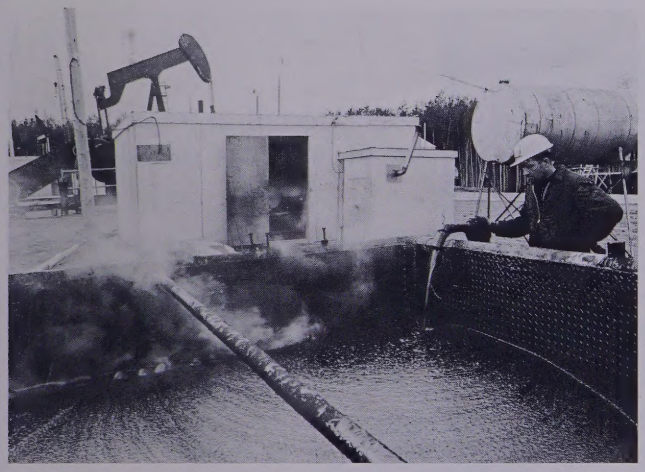
After the heating takes place, a displacement process known as COFCAW is used. This word is made up of the initial letters in Combination Of Forward Combustion And Waterflooding — a new process on which Pan Am holds U.S. and Canadian patents. The injected air moves the combustion front toward producing wells. The addition of water to the injected air in carefully controlled amounts significantly improves the performance.

"The injected water vaporizes and passes through the combustion front, resulting in rapid heat front movement and efficient use of heat," explains Special Research Assistant Woody Craig. "With the combined effects of heat and gas and water drives, the previously heated tar oil is displaced ahead of the combustion front."

Craig, who is in charge of oil field thermal recovery projects at the Tulsa Research Center, predicts wide-spread application of this new recovery method in conventional oil fields. "In fact," he

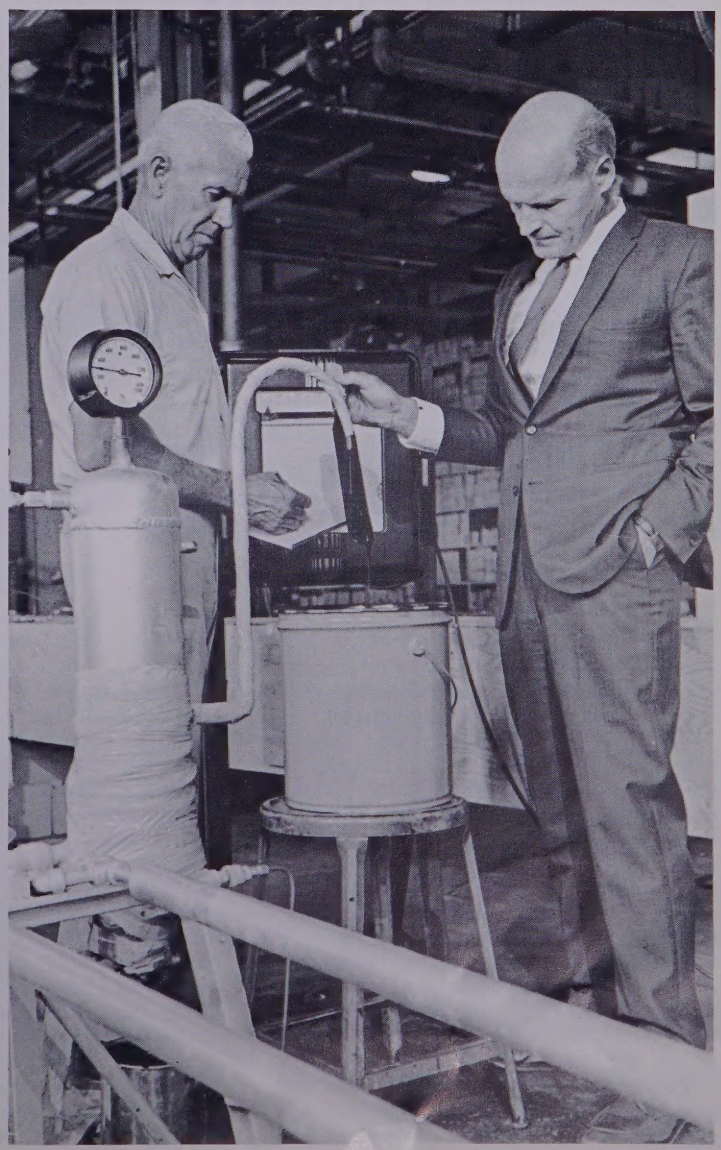
continued on page 5

Experimental work began in the field in 1958. Pan Am employees who worked closely with the project in its early stages are familiar with this landing site on frozen Lake Gregoire. Today there is a landing strip at the test site.



Heated lines carry the tar to tanks. Field Foreman Vic Desaulniers, above, and John Christian alternated at the site during the tests.

Pan American's latest field test is in progress at this site in northeast Alberta. Note the four corner producing wells which surround the injection well. At the time, two of the four wells were equipped with pumping units, and service rigs were over the other two.



Following 10 years of research in both the laboratory and field, Pan Am is confident that its new process can recover at least half of the original bitumen in place. Here at the Research Center, Technician Melvin Clubb, left, and Karol Hujsak, research group supervisor, observe a lab experiment in which we produced Athabasca tar by using our thermal process.

Snowfall averages about 50 inches a year and temperatures dip to -50 and lower in Canada's North country. This picture was taken 10 years ago, soon after field testing got underway.

said, "COFCAW has already been successfully tested in the United States."

As for the Athabasca project, public hearings will be held early next year by the Alberta Conservation Board. If the board approves our production application, the first phase of the new program would begin immediately. This phase involves 44 acres in the area surrounding the field tests. Production would amount to 2,200 barrels daily in 1971.

In 1973, during operation of the second phase, our output should reach about 8,000 barrels daily. Some 75 producing wells and 20 injection wells will be required for the two-phase program.

Lloyd Elkins, director of production research in Tulsa, estimates that Pan Am can recover at least 50 percent of the original bitumen in place by using the new fire-flood method.

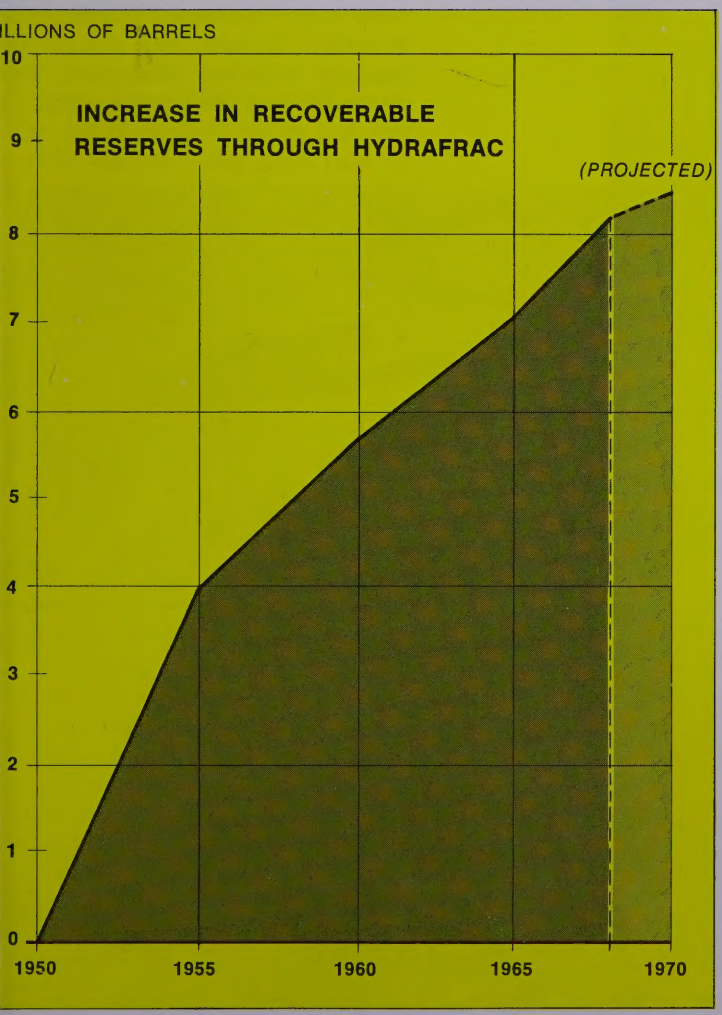
"After more than 10 years of research in the lab and field, we are confident that we have found the answer to producing the reluctant subsurface Athabasca tars," Elkins states.

A decade or two of research may seem like a long time to solve complex problems in our present age of technology. But, in reality, bitumen from the tar sands has defied man's ingenuity for only a brief span of time — considering that the sands were deposited by nature in the Cretaceous Era 100 million years ago.

However you may view time, the tar sands are at last on the threshold of aiding mankind in more ways than the repairing of Indian canoes. **END**

HYDRAFRAC

21 years and 500,000 well treatments later, our patented fracturing process is still going strong



frac has added more than eight billion barrels of recoverable oil, nount equal to nearly 25 percent of all presently known domestic reserves. an American-patented process recently stimulated its 500,000th well southwest Sholem Alechem field of southern Oklahoma.

SERENDIPITY, says Webster's dictionary, "is the gift of finding valuable or agreeable things not sought for." It is this gift of fate or genius which has led to some of the world's most renowned scientific discoveries. Among them: Hydrafrac, the Pan American-developed hydraulic fracturing process which recently energized its 500,000th well.

Today Hydrafrac is the petroleum industry's prime tool for opening formations so tight they could scarcely be produced by any other means. The process has meant much to the industry in terms of production rate by well stimulation. In 1947, few persons would have guessed that a series of experiments, designed only to determine what happens to cement in the formation under squeeze conditions, would lead to a technique that has added over eight billion barrels of oil to recoverable reserves.

Eight billion barrels . . . oil to produce enough gasoline to power all of the nation's 80 million automobiles for more than six years . . . or over 50 times more oil than has been produced in Spindletop since its discovery in 1901.

Although the principles of Hydrafrac were discovered to some extent by happenstance, Pan American scientists since have spent years of research perfecting both the technique and the tools of hydraulic fracturing.

One of the men who are most responsible for Hydrafrac's beginnings is Floyd Farris, who today is a special research associate at the Tulsa Research Center. It was Farris' theories, evolved from close association with the squeeze cementing tests, that eventually led to Pan American's first Hydrafrac patent in 1948.

Farris was joined in the early testing phase by Joe Clark, George Howard and Bob Fast. Clark, who is now a research section supervisor, also obtained a patent on a process using one of the first gelling agents used in the process. These four men, all members of the production research division, were honored in 1967 with the first multiple award ever given by the Society of Petroleum Engineers of AIME.

Back in early 1944 during the cement

continued on next page

Hydrafrac's growth has been meteoric. Today, an average of 1,500 to 1,600 treatments take place each month on wells scattered throughout the world. The first Hydrafrac field test, above, was conducted on this well in Kansas' Hugoton field in July, 1947.

injection tests, Farris noticed that pressur tended to climb as liquid cement slurry w forced into the formation — then fell o markedly. He reasoned correctly that th slurry was actually splitting the rocks in th formation and that pressures declined as th liquid poured into the fractures.

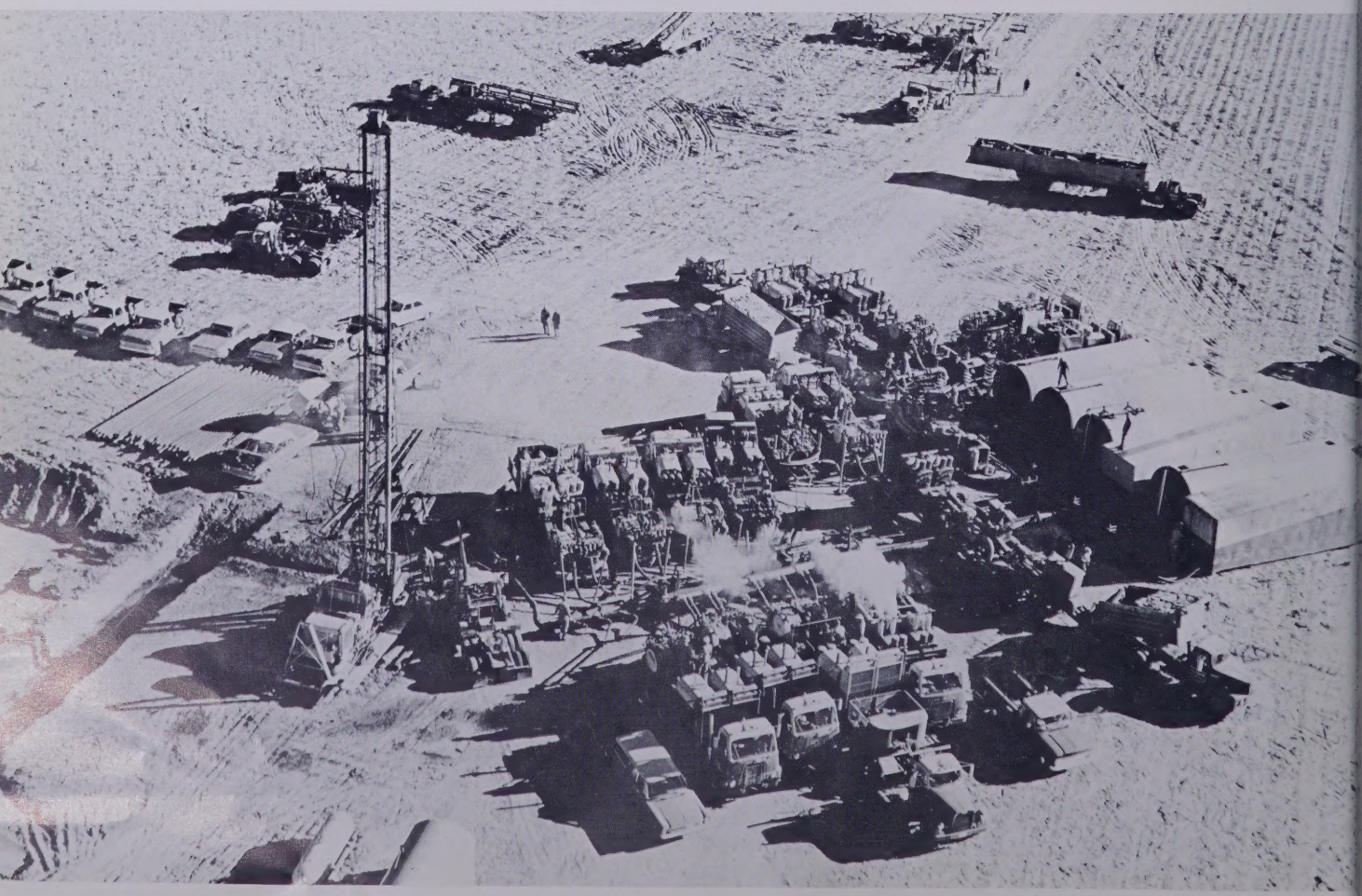
The entire Hydrafrac process stemme from this phenomenon. Farris reasoned tha if enough pressure could be applied to spl the rock layers in tight formations where o and gas were known to exist, hydrocarbo could flow more easily toward producin wells. All that would be necessary would b to remove the fracturing liquid after its wor was done.

After working with various fluids to pe fect a usable fracturing medium, the grou conducted the industry's first Hydrafrac fiel test in July, 1947, on a well known as th No. 1 Klepper in Kansas' Hugoton field.

"It was a success," Farris said, "despi the fact that we almost burned the rig dow with some of the highly inflammable fra turing fluid we were using. We did, howeve establish pay in two previously nonprodu tive zones in the well and thereby prov the process would work."

Other successful experiments followed o wells in the Frannie and Elk Basin fields i Wyoming. In each case, the process dra matically improved production. But the Hydrafrac had its worst setback. In th

On large jobs, hundreds of thousands of gallons of fluid are pumped from trucks into the formation to fracture the producing zone. Below, one of Pan Am's licensees, Halliburton Company, performs a big job in western Kansas.



ngely field in Colorado, the technique denly went sour and failed to produce in straight tests.

Howard, now a research group supervisor, on the scene during the unsuccessful es. "What we didn't realize until later," recalls, "was that sand we were mixing the fracturing liquid to keep the for- tion propped open had to be clean. In Rangely tests, we were dredging up sand of a nearby river and it contained twigs leaves — completely unsuitable."

Before the tests could be discontinued, wever, Hydrafrac had scored its biggest mph — this time in the East Texas field and from then on, there was no doubt of potential value.

Pan American obtained its first patent the process in 1952. Licensing was begun 1949 on an exclusive basis to Halliburton mpany, and then was opened up four rs later to include some two dozen well vicing firms. Today Halliburton and the well Division of Dow Chemical Com- y together perform about 80 percent of industry's hydraulic fracturing jobs.

n the intervening years many of the in- try's concepts about hydraulic fracturing e changed, although the basic idea re- ins the same. A number of supplemen- y patents have been obtained by Pan Am other oil companies and by service firms. The highly inflammable gasoline-alumi- n soap fracturing fluid which was used the early years has long since been re- ced. Crude oil and water-base fracturing ds are now used predominantly.

"At first we were afraid to put water into formation because we thought it would ck the flow of oil," said Bob Fast, now research associate, "but today about 70 cent of all Hydrafrac treatments are ter-based."

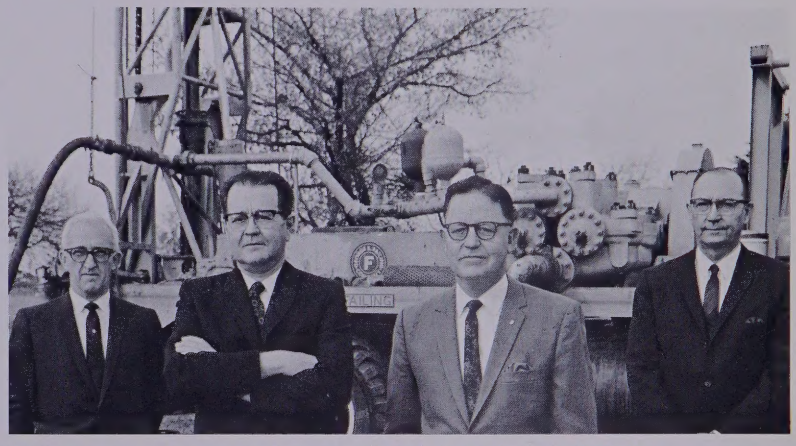
Hydraulic fracturing jobs, in general, are nsiderably larger than their counterparts the early 1950s. The average Hydrafrac atment today runs about 20,000 gallons, contrast to about 750 gallons some 20 rs ago. "However," Fast said, "it's not common for some wells to require as ch as 500,000 gallons and sometimes re."

Although Farris, Howard, Fast and Clark re the four men most generally associated h Hydrafrac's development, there were ny others who made substantial contribu- ns to its progress. It was, like so many dern engineering achievements, a true m effort.

Hydrafrac's impact on the industry is ficult to assess. In addition to the eight ion barrels it has added to recoverable erves, it has opened up new avenues growth for scores of companies — par- ularly those in the well servicing business. To Pan American, Hydrafrac has meant ny millions of dollars over the years. In fact, it is the company's largest source of royalty income.

But it may be the industry itself that has benefited the most. Fast said recently that Canada's Pembina field, the Spraberry field of West Texas and the Basin Dakota field of New Mexico and Colorado simply would not have made it without Hydrafrac. They were too "tight". Many other fields, he added, have had their production and ultimate producible reserves substantially increased by its use.

Just how many Pembinas and Spraberrys the process will help to develop in the next few years is anyone's guess. But one thing seems certain: aided by continually improving methods and better equipment, Hydrafrac is destined to play a key role in the nation's ever-increasing search for new petroleum supplies. **END**



While many Pan Am researchers contributed their talents to Hydrafrac, these four men were instrumental in developing the process. From left: George Howard, Joe Clark, Bob Fast and Floyd Farris. Farris and Clark acquired the industry's first two basic patents. Howard and Fast saw the stimulation process through its early, critical years of testing.

A reunion at the historic 500,000th frac job brought together two of the four Pan Am inventors and three Halliburton men who were on the first Hydrafrac job. From left: Bob Fast, Pan Am research associate; Bill Ball, Halliburton engineer; George Howard, Pan Am research group supervisor; Frank Cox, Pan Am's Oklahoma City area superintendent; A. B. Waters, Halliburton engineer; and Bill Owsley, Halliburton senior vice president.

Amoco Chemicals Corporation, a Pan American affiliate, is a significant supplier of several petrochemicals, including polypropylene and polystyrene, used in manufacturing popular toys like these surrounding James Russell, four-year-old son of Vernie Russell of the General Office comptroller's department.